

ภาคผนวกที่ 4

ใบรับรองการสอบเทียบเครื่องมือ

TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location		Date	
Project Site		February 23, 2022	
Sampler Number		TSP No.7	Transfer Standard Type
Motor Serial Number		BL-07	Calibrator Model
Recorder Serial Number		-	Calibrator Serial Number
		TE-5025A	Person
		1	Mr.Preecha Srisuk

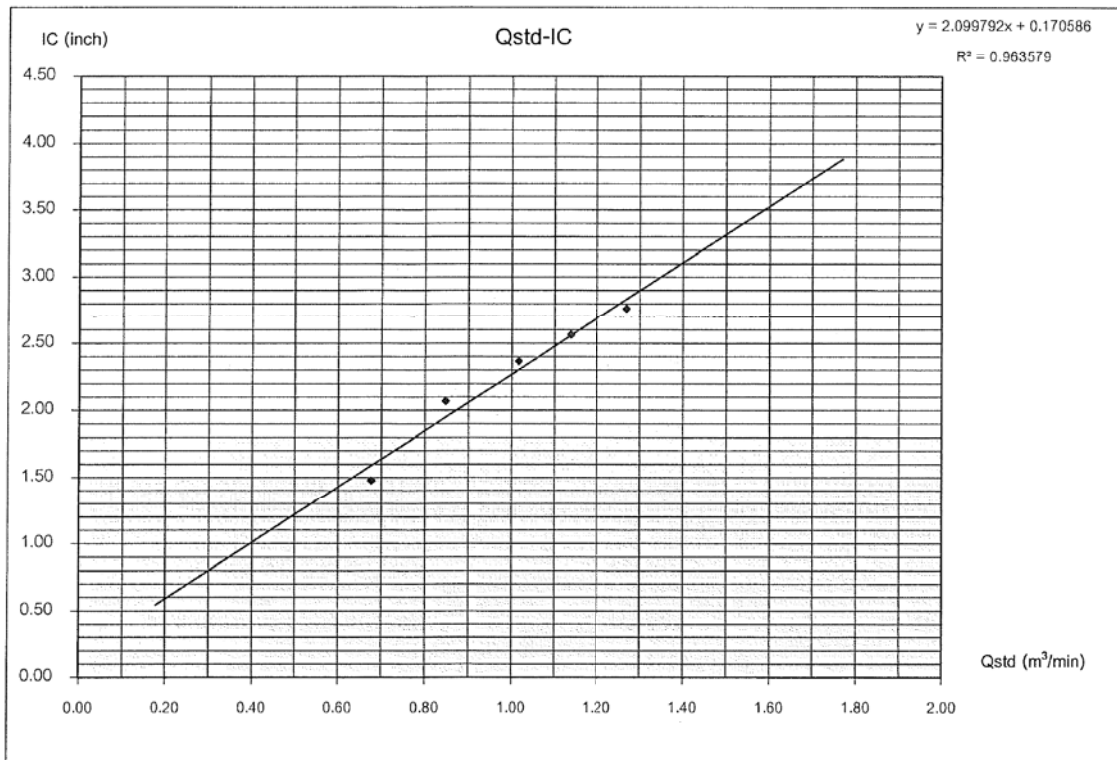
Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop
	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	Sample Flow Rate Indicator	$IC = [(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	(*K = °C+273)	Pressure	Meter	Meter
	Positive	Negative	ΔH_2O		(m ³ /min)	(inch)			(mmHg)		
5	0.9	0.9	1.8	1.32354	0.67721	1.5	1.48	305.0	757.0		
7	1.4	1.4	2.8	1.65074	0.84621	2.1	2.07	305.0	757.0		
10	2.0	2.0	4.0	1.97301	1.01664	2.4	2.37	305.0	757.0		
13	2.5	2.5	5.0	2.20589	1.13834	2.6	2.56	305.0	757.0		
18	3.1	3.1	6.2	2.45638	1.26925	2.8	2.76	305.0	757.0		

Linear Regression Y ON X : Y= mX + b

1	Slope (m)	1.91345	Linear Equation		r^2	0.963579	Pstd(mmHg)	760.0
2	Intercept (b)	0.02773	Set Point Flow Rate (X) (m ³ /min)	1.133	r	0.9816206	T _{std}	298.0
3	Correlation Coefficient (r)	0.99995	Final Set Flow Rate = (I)	0	(Pa/Pstd)*(Tstd/Ta)	0.973192407		
Result					C=(Pa/Pstd)*(Tstd/Ta)*0.5	0.986505148		

COMMENT

Andersen Instruments, Inc.



Calibrated By

Field Environmental

Approved By

Division Manager

TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	February 23, 2022
Project Site				Start Time	9:30 AM
Sampler Number	TSP No.2	Transfer Standard Type	Orifice	Stop Time	9:35 AM
Motor Serial Number	BL-02	Calibrator Model	TE-5025A	Person	Mr.Preecha Snsuk
Recorder Serial Number	-	Calibrator Serial Number	1		

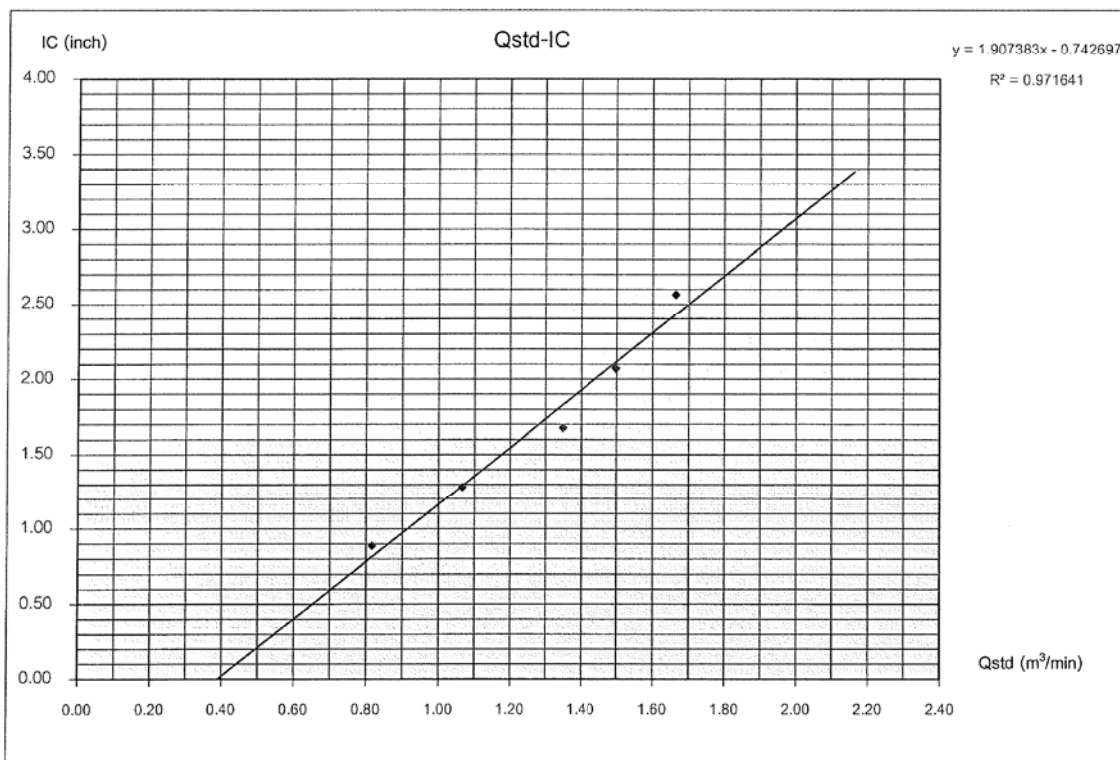
Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Positive	Negative	ΔH_2O	$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	Sample Flow Rate Indicator (inch)	$IC = [(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	(°K = °C+273)	(mmHg)		
5	1.3	1.3	2.6	1.59069	0.81683	0.9	0.89	305.0	757.0		
7	2.2	2.2	4.4	2.06931	1.06696	1.3	1.28	305.0	757.0		
10	3.5	3.5	7.0	2.61005	1.34956	1.7	1.68	305.0	757.0		
13	4.3	4.3	8.6	2.89300	1.49744	2.1	2.07	305.0	757.0		
18	5.3	5.3	10.6	3.21183	1.66406	2.6	2.56	305.0	757.0		

Linear Regression Y ON X : Y= mX + b

1	Slope (m)	1.91345	Linear Equation		Average	305.0	757.0		
2	Intercept (b)	0.02773	Set Point Flow Rate (X) (m ³ /min)		1.133	r^2	0.971641	Paid(mmHg)	760.0
3	Correlation Coefficient (r)	0.99995	Final Set Flow Rate = (I)		0	r	0.9857185	T _{NTP}	298.0
Result							$C = (Pa/P_{std})(T_{std}/T_a)^{0.5}$		0.98505148

COMMENT

Andersen Instruments, Inc.



Calibrated By

Field Environmental

Approved By

Division Manager

PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

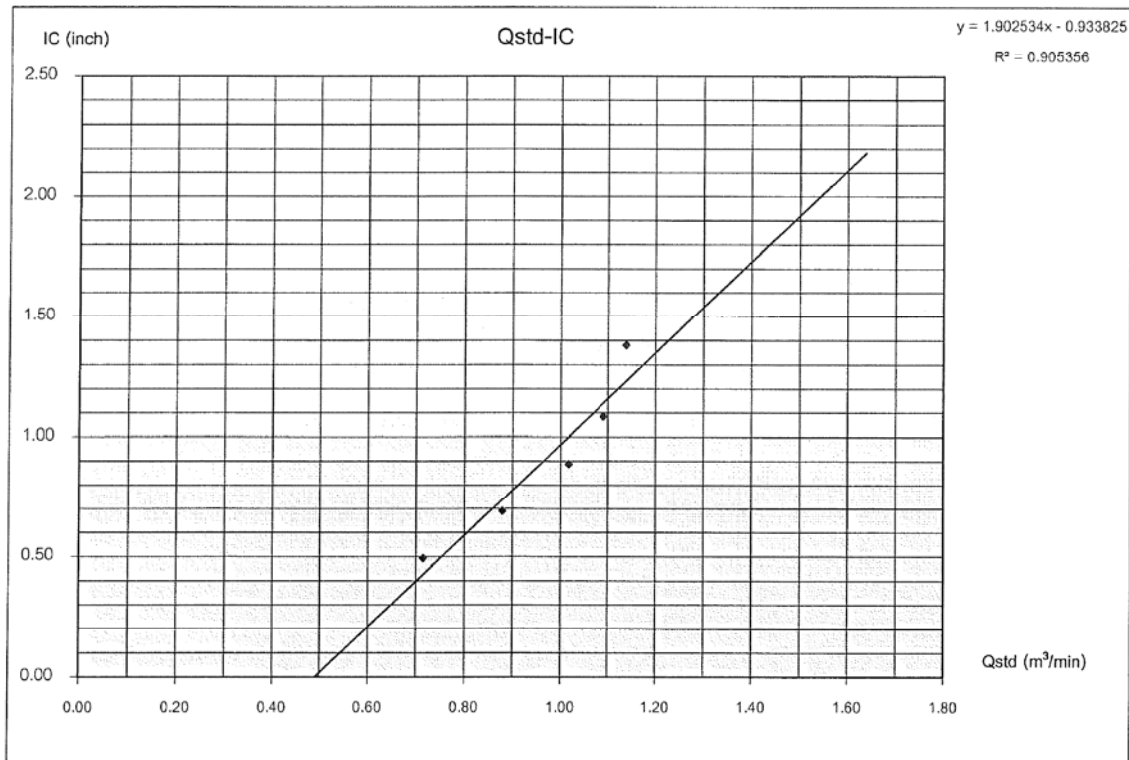
Sampler Location				Date	February 23, 2022
Project Site				Start Time	12:40 PM
Sampler Number	PM-10 No.10	Transfer Standard Type	Orifice	Stop Time	12:45 PM
Motor Serial Number	HVL-10	Calibrator Model	TE-5025A	Person	Mr.Preecha Srisuk
Recorder Serial Number	-	Calibrator Serial Number	1		

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	Sample Flow Rate Indicator (inch)	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	(°K = °C+273)	(mmHg)		
	Positive	Negative	ΔH ₂ O								
5	1.0	1.0	2.0	1.39513	0.71462	0.5	0.49	305.0	757.0		
7	1.5	1.5	3.0	1.70868	0.87849	0.7	0.69	305.0	757.0		
10	2.0	2.0	4.0	1.97301	1.01664	0.9	0.89	305.0	757.0		
13	2.3	2.3	4.6	2.11582	1.09127	1.1	1.09	305.0	757.0		
18	2.5	2.5	5.0	2.20589	1.13834	1.4	1.38	305.0	757.0		
Linear Regression Y ON X : Y= mX + b								Average	305.0	757.0	

1	Slope (m)	1.91345	Linear Equation		r^2	0.905356	Pstd(mmHg)	760.0
2	Intercept (b)	0.02773	Set Point Flow Rate (X) (m ³ /min)	1.133	r	0.951502	T _{std}	298.0
3	Correlation Coefficient (r)	0.99995	Final Set Flow Rate = (I)	0	(Pa/Pstd)*(Tstd/Ta)	0.973192407		
Result							C=(Pa/Pstd)*(Tstd/Ta)^0.5	0.986505148

COMMENT

Andersen Instruments, Inc.



Calibrated By

Field Environmental

Approved By

Division Manager

PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

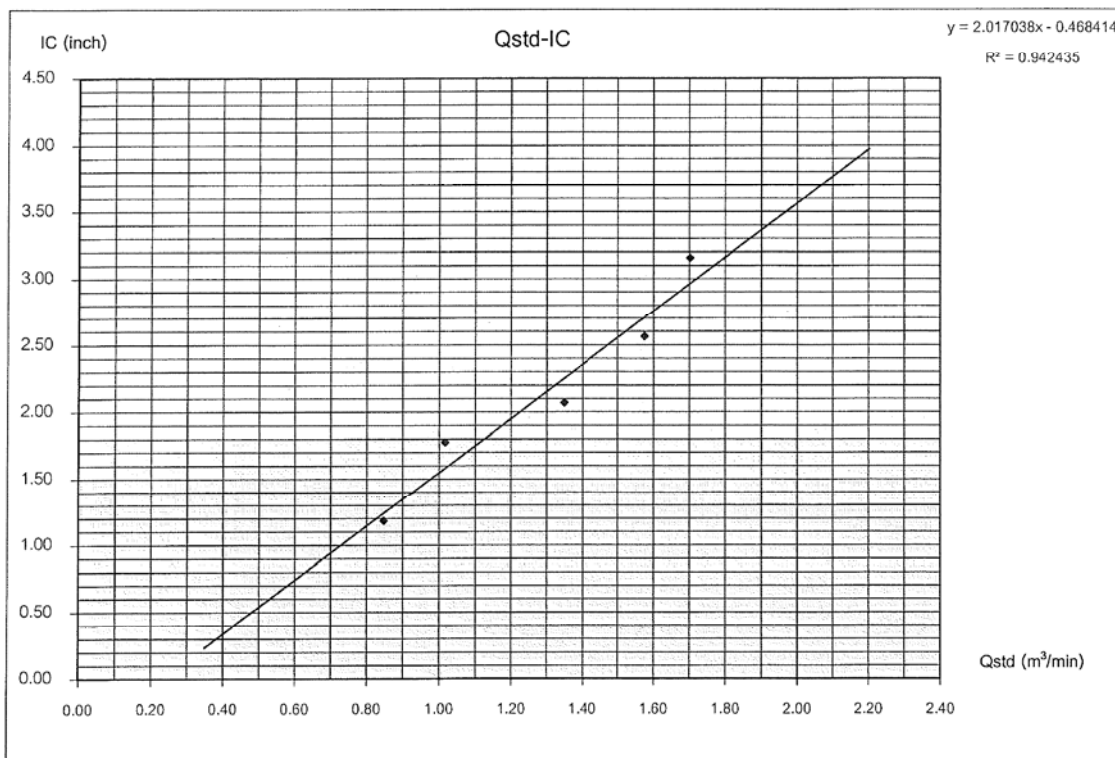
Sampler Location				Date	February 23, 2022
Project Site				Start Time	9:30 PM
Sampler Number	PM-10 No.3	Transfer Standard Type	Orifice	Stop Time	9:35 PM
Motor Serial Number	HVL-03	Calibrator Model	TE-5025A	Person	Mr.Preecha Srisuk
Recorder Serial Number	-	Calibrator Serial Number	1		

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	Sample Flow Rate Indicator (inch)	$IC = \{[(Pa/P_{std})(T_{std}/T_a)]^{1/2}\}$ (°K = °C+273)		(mmHg)		
	Positive	Negative	ΔH ₂ O								
5	1.4	1.4	2.8	1.65074	0.84821	1.2	1.18	305.0	757.0		
7	2.0	2.0	4.0	1.97301	1.01664	1.8	1.78	305.0	757.0		
10	3.5	3.5	7.0	2.61005	1.34956	2.1	2.07	305.0	757.0		
13	4.7	4.8	9.5	3.04061	1.57456	2.6	2.56	305.0	757.0		
18	5.5	5.6	11.1	3.26671	1.70319	3.2	3.16	305.0	757.0		

Linear Regression Y ON X : Y = mX + b								Average	305.0	757.0	
1	Slope (m)	1.91345	Linear Equation					r ²	0.942435	Pstd(mmHg)	760.0
2	Intercept (b)	0.02773	Set Point Flow Rate (X) (m ³ /min)				1.133	r	0.9707909	T _{std}	298.0
3	Correlation Coefficient (r)	0.99995	Final Set Flow Rate = (I)				0	(Pa/Pstd)*(Tstd/Ta)		0.973192407	
Result								C=(Pa/Pstd)*(Tstd/Ta)*0.5		0.986505148	

COMMENT

Andersen Instruments, Inc.



Calibrated By ...
Field Environmental

Approved By ...
Division Manager



บริษัท เอ็นไวร์ เซอร์วิส จำกัด

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
 บริษัท เอ็นไวร์ เซอร์วิส จำกัด
 ENVIR SERVICE CO., LTD. 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bankok 10230 Tel : 02-9435814-5 Fax : 02-9438201

Analyzer Performance Test

Calibrated Date: 16 March 2022

Instruments Information

Analyzer Type: NO/NO ₂ /NO _x Analyzer Model: 42C	Manufacturer Thermo Environmental S/N: 42C-33500-371
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API Model 701 S/N: 1924	NO Conc 55.47 PPM SO ₂ Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

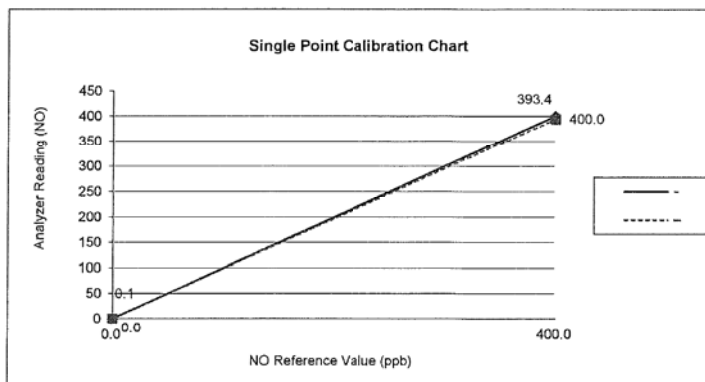
Humidity: 51 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.1	0.0	0.1	393.4	400.0	-1.7
NO _x	0.1	0.0	0.1	396.7	400.0	-0.8

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.0	0.0	0.0	400.0	400.0	0.0
NO _x	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By :



บริษัท เอ็นไวร์ เซอร์วิส จำกัด

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
 บริษัท เอ็นไวร์ เซอร์วิส จำกัด
 ENVIR SERVICE CO., LTD. 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bankok 10230 Tel : 02-9435814-5 Fax : 02-9438201

Analyzer Performance Test

Calibrated Date: 16 March 2022

Instruments Information

Analyzer Type: NO/NO ₂ /NO _x Analyzer Model: 42C	Manufacturer Thermo Environmental S/N: 42C-601114773
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API Model 701 S/N: 1924	NO Conc 55.47 PPM SO ₂ Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

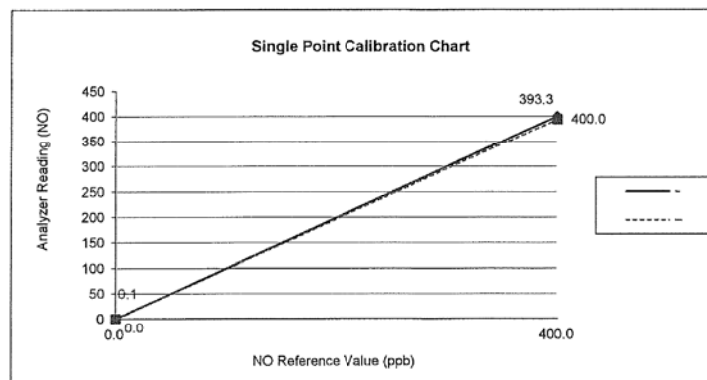
Humidity: 51 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.1	0.0	0.1	393.3	400.0	-1.7
NO _x	0.1	0.0	0.1	396.4	400.0	-0.9

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.0	0.0	0.0	400.0	400.0	0.0
NO _x	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By :



บริษัท เอ็นไวร์ เซอร์วิส จำกัด

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
บริษัท เอ็นไวร์ เซอร์วิส จำกัด 42 Raminthra 14 yeak 9, Tha Rang, Bangkok, Bangkok 10230 Tel : 02-9435814-5 Fax : 02-9438201
ENVIR SERVICE CO., LTD.

Analyzer Performance Test

Calibrated Date: 16 March 2022

Instruments Information

Analyzer Type: SO2 Analyzer Model: 43C	Manufacturer Thermo Environmental S/N: 43C-33500-719
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Calibration System

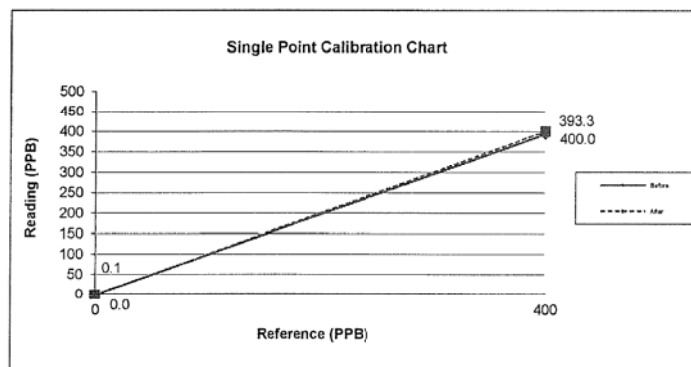
Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API MODEL 701 S/N: 1924	NO Conc 55.47 PPM SO2 Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

Humidity: 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPB)	Reading (PPB)	Drift (PPB)	Reference (PPB)	Reading (PPB)	Drift%
Before	0.0	0.1	0.1	400.0	393.3	-1.7
After	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By :





บริษัท เอ็นไวร์ เซอร์วิส จำกัด

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
บริษัท เอ็นไวร์ เซอร์วิส จำกัด 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bangkok 10230 Tel : 02-9435814-5 Fax : 02-9438201
ENVIR SERVICE CO., LTD.

Analyzer Performance Test

Calibrated Date: 16 March 2022

Instruments Information

Analyzer Type: SO2 Analyzer Model: 43C	Manufacturer Thermo Environmental S/N: 43C-71354-368
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Calibration System

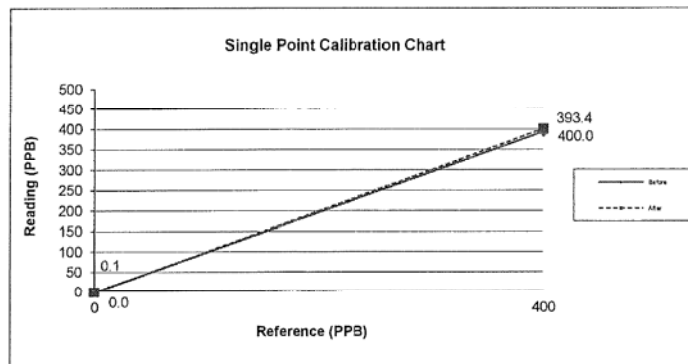
Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API MODEL 701 S/N: 1924	NO Conc 55.47 PPM SO2 Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

Humidity: 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPB)	Reading (PPB)	Drift (PPB)	Reference (PPB)	Reading (PPB)	Drift%
Before	0.0	0.1	0.1	400.0	393.4	-1.7
After	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By :





บริษัท เอ็นไวร์ เซอร์วิส จำกัด

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
บริษัท เอ็นไวร์ เซอร์วิส จำกัด
ENVIR SERVICE CO., LTD. 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bankok 10230 Tel : 02-9435814-5 Fax : 02-9438201

Analyzer Performance Test

Calibrated Date: 16 March 2022

Instruments Information

Analyzer Type: CO Analyzer Model: 300	Manufacturer API S/N: 200-S
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Calibration System

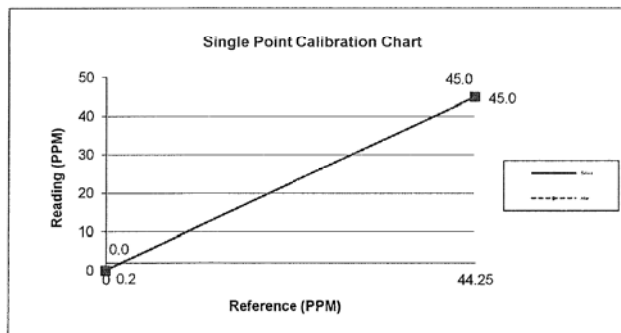
Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API MODEL 701 S/N: 1924	NO Conc 55.47 PPM SO2 Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

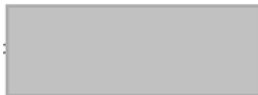
Humidity: 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.2	0.2	44.3	45.0	1.7
After	0.0	0.0	0.0	45.0	45.0	0.0



Calibrate By :





บริษัท เอ็นไวร์ เซอร์วิส จำกัด

42 รามอินทรา 14 แขวง 9 เขตจตุจักร กรุงเทพมหานคร 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
บริษัท เอ็นไวร์ เซอร์วิส จำกัด
ENVIR SERVICE CO., LTD. 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bankok 10230 Tel : 02-9435814-5 Fax : 02-9438201

Analyzer Performance Test

Calibrated Date: 16 March 2022

Instruments Information

Analyzer Type: CO Analyzer Model: 300	Manufacturer API S/N: 203-S
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Calibration System

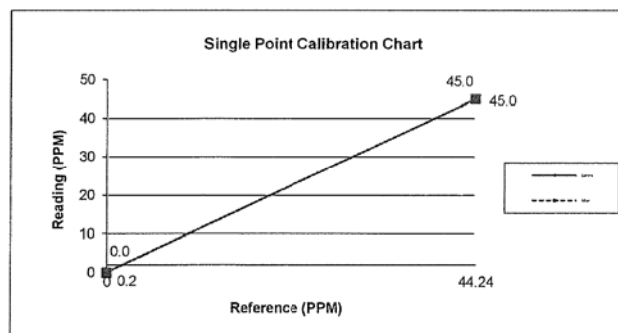
Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API MODEL 701 S/N: 1924	NO Conc 55.47 PPM SO ₂ Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

Humidity: 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.2	0.2	44.2	45.0	1.7
After	0.0	0.0	0.0	45.0	45.0	0.0



Calibrate By :



Certificate of Calibration

Certificate No. : 65-420003-2

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T. Bangrakpattana, A. Bangbuatong, Nonthaburi 11110

Equipment : pH Meter with electrode

pH meter

Manufacturer : Thermo Scientific Model : pH 150

Range : N/A pH Resolution : 0.01 pH

Serial No. : 2913288 ID No. : MET-PH05/63

Electrode

Model : N/A Serial No. : 48393

Environment : Ambient Temperature : $(25 \pm 2) ^\circ \text{C}$

Relative Humidity : $(50 \pm 15) \%$

Date of Received : 13 January 2022

Date of Calibration : 19 January 2022

Date of Issue : 19 January 2022

Calibrated by : Bunjerd Masri

Calibration Method : In-house method CAL-M4201 direct measurement by using standard voltage calibrator and using certified reference material (CRM)

Reference Standard Instruments : This certification is traceable to the International System of Units

1. Multiproduct Calibrator

ID No.	Cert. No.	Due Date	Traceability
440001	21E997	17 Mar 2023	National Institute of Metrology Thailand (NIMT)

2. Standard Buffer Solution

pH	Cert. No.	Lot No.	Exp. Date	Traceability
4.004	61218215	769926	15 May 2022	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025
6.985	61223875	769927	15 May 2022	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025
9.963	61208865	769928	15 May 2022	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025

Approved by :



The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full except with the prior written approval of the Calibratech Co.,Ltd.



Certificate of Calibration

Certificate No. : 65-420003-2

Page : 2 of 2

Result of Calibration :

UUC Condition As-Received : Good

Function : Electrical measurement

pH meter

Performing standard curve by Multiproduct Calibrator at pH (4,7,10)

Adjustment Curve at nominal pH	Applied Voltage (mV)	Nominal Value (pH)	UUC Reading		Correction (mV)	Uncertainty (± mV)
			(pH)	(mV)		
4, 7, 10	177.4800	4	4.00	177.5	0.0	0.060
	0.0000	7	7.00	0.2	-0.2	0.058
	-177.4800	10	10.00	-177.2	-0.3	0.060

Function : pH meter with electrode

Performing a three - buffer standard curve using buffer nominal pH (4,7,10)

Adjustment Curve at nominal pH	Standard Buffer (pH)	UUC Reading (pH)	Correction (pH)	Uncertainty (± pH)
4, 7, 10	4.004	4.01	0.00	0.011
	6.985	7.00	-0.01	0.011
	9.963	10.01	-0.04	0.016

Remark

UUC : Unit Under Calibration

This result of calibration was found accurate as shown on date and place of calibration only.

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%

- oOo -



Certificate of Calibration

Certificate No. : 65-400021-2

Page : 1 of 2

Submitted by : M E T Company Limited
6/659 Moo 6, T. Bangrakpattana, A. Bangbuatong, Nonthaburi 11110

Equipment : Digital Thermometer with Thermistor Probe
Temperature Indicator

Manufacturer :	Thermo Scientific	Model :	pH 150
Range :	N/A	Resolution :	0.1 °C
Serial No. :	2913288	ID No. :	MET-PH05/63
Thermistor Probe			
Model :	PHWPTM01W	Sheath Material :	Stainless
Diameter :	3 mm.	Length :	85 mm.
Serial No. :	459	ID No. :	MET-PH05/63

Environment : Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 15) %
Line Voltage : (220 ± 22) VAC

Date of Received : 13 January 2022

Date of Calibration : 19 January 2022

Date of Issue : 19 January 2022

Calibrated by : Chortip Samchusri

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4003 by compared with PRT in the liquid bath at the constant controlled temperature.

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units

1. Platinum Resistance Thermometer (PRT)

ID No.	Cert. No.	Due Date	Traceability
400001	TT-0016-20	04 Mar 2022	National Institute of Metrology Thailand (NIMT)

2. Standard Digital Thermometer

ID No.	Cert. No.	Due Date	Traceability
400003	21E1850	14 Jun 2023	National Institute of Metrology Thailand (NIMT)
400004	21E1850	14 Jun 2023	National Institute of Metrology Thailand (NIMT)

Approved by :



The Uncertainties are for a confidence probability of approximately 95%

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Calibratech Co.,Ltd.

7/106-7 Moo 2, Sukhprachasan 3 Rd., Bangpood, Pakkred, Nonthaburi 11120

Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech_cal@yahoo.com, calibratech_cal@hotmail.com

Certificate of Calibration

Certificate No. : 65-400021-2

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
85	10.0024	10.1	-0.1	0.11
85	50.0038	50.4	-0.4	0.11

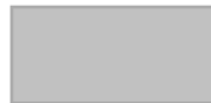
Remark

UUC : Unit Under Calibration

This result of calibration was found accurate as shown on date and place of calibration only.

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%

- ๐0๐ -



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NSC-TISI-TIS 17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 64-400425-5

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Air Chamber (Incubator)

Manufacturer : M-LAB

Model : BIC-140

Range : N/A °C

Resolution : 0.1 °C

Serial No. : 240412

ID No. : MET-BI01/55

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited

Ambient Temperature : (31.0 to 33.0) °C

Relative Humidity : (50 to 55) %

Line Voltage : (210.0 to 210.8) V

Date of Received : 23 August 2021

Date of Calibration : 23 August 2021

Date of Issue : 23 August 2021

Calibrated by : Permpoon Chanpu

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units
Standard Digital Thermometer with Thermocouple probe

<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>	<u>Traceability</u>
400029 & 400032	64-400106-1	30 Sep 2021	National Institute of Metrology Thailand (NIMT)

Approved by :



The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 64-400425-5

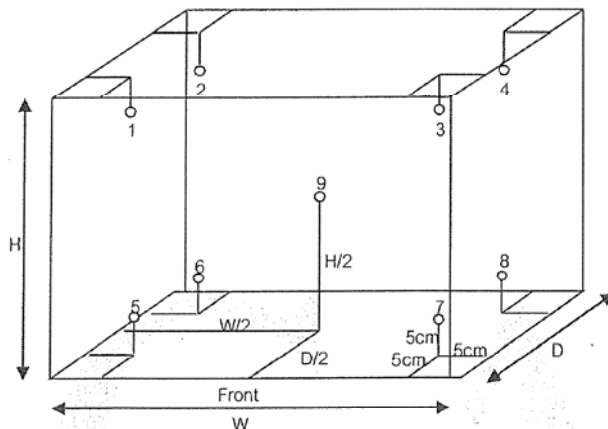
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.37 m

D = 0.33 m

H = 1.14 m

Capacity = 0.14 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
20.0	20.0	20.0	19.9	19.8	19.7	19.5	20.4	20.4	20.3	20.1	20.4	0.57

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
20.0	20.0	20.0	1.0	0.1	1.0

Remark The uncertainty is not combine uniformity of the air chamber

This result of calibration was found accurate as shown on date and place of calibration only.

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k = 2 , providing a level of confidence of approximately 95%

- o0o -



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NSC-TISI-TIS 17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 64-400425-2

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Air Chamber (Oven)

Manufacturer : Binder

Model : ED53

Range : N/A °C

Resolution : 1 °C

Serial No. : 13-07419

ID No. : MET-OV02/57

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited

Ambient Temperature : (31.0 to 33.0) °C

Relative Humidity : (50 to 55) %

Line Voltage : (210.0 to 210.8) V

Date of Received : 23 August 2021

Date of Calibration : 23 August 2021

Date of Issue : 23 August 2021

Calibrated by : Permpon Chanpu

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units
Standard Digital Thermometer with Thermocouple probe

ID No.

Cert. No.

Due Date

Traceability

400029 & 400030

64-400104-1

29 Sep 2021

National Institute of Metrology Thailand (NIMT)

Approved by :



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Certificate of Calibration

Certificate No. : 64-400425-2

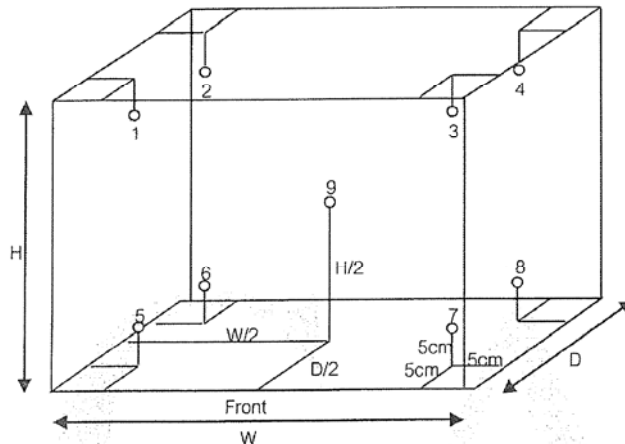
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.40 m

D = 0.33 m

H = 0.40 m

Capacity = 0.05 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
104	109	109	104.8	105.0	104.4	104.6	103.4	103.5	103.6	103.7	103.7	0.96
180	184	184	180.8	181.8	179.9	180.6	180.6	180.8	180.6	180.9	180.5	1.1

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
104	109	109	1.5	0.2	1.8
180	184	184	1.6	0.2	2.3

Remark The uncertainty is not combine uniformity of the air chamber

This result of calibration was found accurate as shown on date and place of calibration only.

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%

- o0o -



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NSC-TISI-TIS 17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 64-400425-1

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Air Chamber (Oven)

Manufacturer : Memmert

Model : UM 100

Range : N/A °C

Resolution : 0.1 °C

Serial No. : b197.0985

ID No. : MET-OV01/46

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited

Ambient Temperature : (31.0 to 33.0) °C

Relative Humidity : (50 to 55) %

Line Voltage : (210.0 to 210.8) V

Date of Received : 23 August 2021

Date of Calibration : 23 August 2021

Date of Issue : 23 August 2021

Calibrated by : Permpoon Chanpu

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units
Standard Digital Thermometer with Thermocouple probe

ID No.

Cert. No.

Due Date

Traceability

400029 & 400032

64-400106-1

30 Sep 2021

National Institute of Metrology Thailand (NIMT)

Approved by :



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Certificate of Calibration

Certificate No. : 64-400425-1

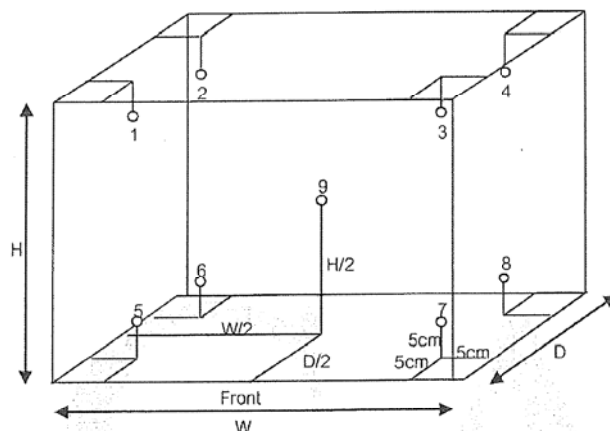
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

$$W = 0.32 \quad \text{m} \cdot$$
$$D = 0.18 \quad \text{m}$$
$$H = 0.24 \text{ m}$$
$$\text{Capacity} = 0.01 \text{ m}^3$$

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
180.0	180.0	180.0	180.9	181.2	180.7	181.0	181.1	181.3	180.6	180.7	179.6	0.95

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
180.0	180.0	180.0	1.9	0.2	2.0

Remark The uncertainty is not combine uniformity of the air chamber

This result of calibration was found accurate as shown on date and place of calibration only.

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%

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Packing List

Unit : K-446 Kjeldigester standard



151111112791000281006111

Serial Number

1000281006

Page 1(1)

Item	Pieces	Description		
11059833	1.0000	Packing parts Kjeldigester K-446/K-449 Beipackteile K-446/K-449		✓ OK
037377	5.0000	Sample tubes 300 ml (set of 4) Probengläser 300 ml (Set à 4 Stück)		✓ OK
11059754	1.0000	Rack 20 cpl. Rack 20 kpl.		✓ OK
11058955	1.0000	Aspiration device Kjeldigester K-446/K-449 cpl. Absaugeinheit K-446/K-449		✓ OK
040444	1.0000	Weighing boat 20pcs. Wägeschiffchen 20 Stk.		✓ OK
010020	1.0000	Power cable type USA, 3 pole 120V Anschlusskabel USA W 120V		✓ OK
11058825	1.0000	Fume collection tube with ball joint Dampfsammelrohr mit Kugelschliff		✓ OK
11592548	1.0000	Kjeldahl Practice Guide en Kjeldahl Practice Guide en		✓ OK
11593546	1.0000	Operation Manual K-446/K-449 english Bedienungsanleitung K-446/K-449 englisch		✓ OK
11593635	1.0000	Supplementary sheet Kjeldigester K-446/K-449 Beiblatt K-446/K-449		✓ OK

Packed by





BUCHI Certificate Final Test Inspection

Unit : BÜCHI KjeldDigester K-446

Serial number : 1000281006

Examination Procedure

- | | |
|--|------------------------------|
| 1. Visual control of the glass parts and the unit
- No scratches on the coated surface
- Mounted in accordance to the specific drawing | ✓ OK |
| 2. Security tests
- High voltage test in accordance with EN 61010-1 (IEC 1010)
- Ground connection test in accordance with EN 61010-1 (IEC 1010) | ✓ OK |
| 3. Functional tests
Operating panel
- All buttons are working
- Cooling system is working after the instrument has been switched on

Connector plugs
- Scrubber connector is working

Heating element
- Heating-up temperature 420 °C is reached after 40 minutes
- Temperature calibration at 420 °C (3 measuring points) | ✓ OK

✓ OK

✓ OK |
| 4. Completeness of order checked | ✓ OK |

BÜCHI Labortechnik AG hereby declares that this unit is in accordance with the specifications



Signature, Date:



Packing List

Unit : K-415 TripleScrub 230V










151111112781000281005111

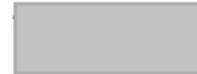
Serial Number

1000281005

Page 1(1)

Item	Pieces	Description		
11057332	1.0000	Tray for adsorption storage Ablage für Adsorption		✓ OK
048355	1.0000	Silicone hose D6/9 L=3m Silikonschlauch D6/9 L=3.0m		✓ OK
033701	1.0000	Glass wool 30g Glaswolle 30g		✓ OK
028737	2.0000	Hose clamp Anschlussklemme		✓ OK
11064971	1.0000	Activated Charcoal 2-6mm, 150g Aktivkohle 2-6mm, 150g		✓ OK
010020	1.0000	Power cable type USA, 3 pole 120V Anschlusskabel USA W 120V		✓ OK
11593505	1.0000	Operation Manual K-415 english Bedienungsanleitung K-415 englisch		✓ OK

Packed by





BUCHI Certificate Final Test Inspection

Unit : BÜCHI Scrubber K-415

Serial number 1000281005

Examination Procedure

1. Visual control of the glass parts and the unit

✓ OK

- No scratches or splinters on the glass parts
- Mounted in accordance to the specific drawing

2. Security tests

✓ OK

- High voltage test in accordance with EN 61010-1 (IEC 1010)
- Ground connection test in accordance with EN 61010-1 (IEC 1010)

3. Functional tests

✓ OK

Vacuum test

- Bypass valve open: Pressure is 0 - 65 mbar below the atmospheric pressure
- Bypass valve closed: Pressure is 400 mbar (+/- 10 %) below the atmospheric pressure

4. Completeness of order checked

✓ OK

BÜCHI Labortechnik AG hereby declares that this unit is in accordance with the specifications



Signature, Date:



Packing List

Unit : K-360 Plastik Basic








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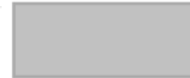
Serial Number

1000281014

Page 1(1)

Item	Pieces	Description		
043410	3.0000	Canister 10L thin-walled Kanister 10L dünnwandig	✓	OK
043603	1.0000	Packing parts K-360 Beipackteile K-360		✓ OK
047871	1.0000	Suppl. sheet distillation unit Beiblatt Distillation Unit		✓ OK
010020	1.0000	Power cable type USA, 3 pole 120V Anschlusskabel USA W 120V		✓ OK
11592548	1.0000	Kjeldahl Practice Guide en Kjeldahl Practice Guide en		✓ OK
093176	1.0000	Operation Manual K-360 english Bedienungsanleitung K-360 englisch		✓ OK

Packed by





BUCHI Certificate Final Test Inspection

Unit : BÜCHI BÜCHI Kjelflex K-360

Serial number 1000281014

Examination Procedure

1. Visual control of the glass parts and the unit ✓ OK
 - No scratches on the coated surface or splinters on the glass parts
 - Mounted in accordance to the specific drawing
2. Security tests ✓ OK
 - High voltage test in accordance with EN 61010-1:2002 (IEC 61010-1,VDE 0411)
 - Ground connection test in accordance with EN 61010-1:2002 (IEC 61010-1,VDE 0411)
 - Safety door sensor checked
3. Functional tests
Electronics ✓ OK
 - Electronic modul is tested with the checking device PG157
 - Connector plugs are workingOperating panel ✓ OK
 - Display is working
 - All buttons of the keypad are workingPump testing ✓ OK
 - All pumps are working
 - All pumps (exception: water pump of the steam generator) are precalibratedValve testing ✓ OK
 - All valves are workingSteam generator testing ✓ OK
 - The steam generator is filled with water
 - The steam generator valve is working
 - The amount of distillate corresponds to specificationsFurther testing ✓ OK
 - Beeper is working
4. Unit configuration and completeness of order checked ✓ OK

BÜCHI Labortechnik AG hereby declares that this unit is in accordance with the specifications



Signature, Date:



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NSC-TISI-TIS 17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 64-200244-1

Page : 1 of 2

Submitted by : M E T Company Limited
36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Electronic Balance
Manufacturer : Sartorius Model : BSA224S-CW
Serial No. : 35090472 ID No. : MET-EB 02/60
Capacity : 220 g Resolution : 0.0001 g

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited
Ambient Temperature : (26.2 to 26.5) °C
Relative Humidity : (45.2 to 45.8) %
Air Pressure : 1007.0 mbar

Date of Received : 23 August 2021

Date of Calibration : 23 August 2021

Date of Issue : 24 August 2021

Calibrated by : Wutthiporn Woraphan

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref : LAB 14
Edition 5, July 2015

Reference Standard Instruments : This certification is traceable to the International System of Units

Standard Weights

<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>	<u>Traceability</u>
E261-E2624	C02204101	17 Nov 2021	National Institute of Metrology (Thailand), (NIMT)

Approved by : _____



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Certificate of Calibration

Certificate No. : 64-200244-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

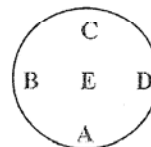
Nominal Value (g)	Correction (g)	Uncertainty \pm (g)
0.05	0.0000	0.00011
0.1	0.0000	0.00011
0.5	-0.0001	0.00011
1	-0.0001	0.00011
5	0.0000	0.00011
10	0.0001	0.00012
50	0.0000	0.00014
100	0.0000	0.00020
150	0.0001	0.00038
200	0.0000	0.00038

This result of calibration was found accurate as shown on date and place of calibration only.

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.11$, providing a level of confidence of approximately 95%

Eccentric error

Load test : 50 g
A B C D E
-0.0001 -0.0001 0.0001 0.0001 0.0000 g



Repeatability

Load test : 200 g
Stdev. : 0.00005 g

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NSC-TISI-TIS 17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 64-400425-3

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Air Chamber (Refrigerator)

Manufacturer : Sanden Intercool

Model : YPR-068S

Range : N/A °C

Resolution : 1 °C

Serial No. : YPR0659S-141200060R

ID No. : MET-RE03/59

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited

Ambient Temperature : (28.6 to 30.5) °C

Relative Humidity : (55 to 58) %

Line Voltage : (220.0 to 220.8) V

Date of Received : 23 August 2021

Date of Calibration : 23 August 2021

Date of Issue : 23 August 2021

Calibrated by : Bunjerd Masri

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units
Standard Digital Thermometer with Thermocouple probe

ID No.

Cert. No.

Due Date

Traceability

400022 & 400023

64-400101-1

01 Sep 2021

National Institute of Metrology Thailand (NIMT)

Approved by :



The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. :64-400425-3

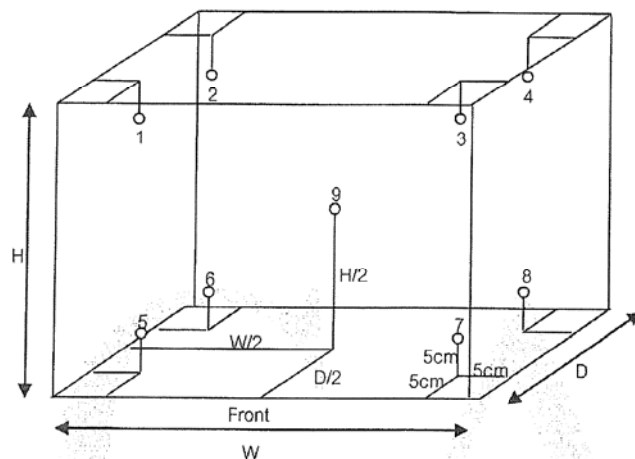
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.58 m

D = 0.60 m

H = 1.45 m

Capacity = 0.50 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
3	2	2	3.6	3.6	3.8	3.5	2.9	3.5	2.9	3.2	3.0	0.83

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
3	2	2	0.8	0.2	1.1

Remark The uncertainty is not combine uniformity of the air chamber

This result of calibration was found accurate as shown on date and place of calibration only.

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%

- o0o -





บริษัท เอ็ม อี ที จำกัด MET Company Limited

36/659 หมู่ 6 ต.บางรักพัฒนา อ.บางบัวทอง จ.นนทบุรี 11110

36/659 Moo 6 Tambol Bangrakpattana Amphur Bangbuatong Nontaburi 11110

Tel : 0 2920 1458-9 Fax : 0 2920 1460 E-mail : met_jj@yahoo.com

Sound Level Meter Calibration Report

Calibration Report No. : 6502002

Calibrated Date : 23 February 2022

Acoustic Calibrator Data

Brand	:	RION	Serial No.	:	34480442
Model	:	NC-75	Last Calibration	:	6 September 2021
Range of Calibration	:	94 dB, 1000 Hz	Due Date	:	6 September 2022

Calibration Data

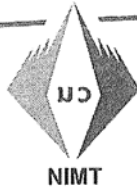
Brand	Serial No.	Actual Reading [dB(A)]	
		Before Adjustment	After Adjustment
ACO 6226	080086	94.1	94.0
ACO 6226	150067	94.1	94.0

Calibrated by : _____



Approved by : _____





National Institute of Metrology (Thailand)

Certificate of Calibration

Certificate No. : AA-2013-21
Issued by : Acoustics Laboratory
Acoustics and Vibration Group



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MEASUREMENT ITEM : Sound Calibrator
MANUFACTURER : RION
MODEL/TYPE : NC-75
SERIAL NUMBER : 34480442
CUSTOMER : MET Co., Ltd.
36/659 Moo 6, T. Bangrakphatthana,
Bangbuathong, Nonthaburi 11110
MEASUREMENT DATE : 6 September 2021

*The calibration results only marked with an asterisk * in this certificate are not included in Appendix C of the MRA drawn up by the CIPM.*

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. This calibration certificate may not be reproduced other than in full except with the permission of the Director of National Institute of Metrology (Thailand).

Reference
AUV084-01/21

Date
6 September 2021

Authorized Signatory

Person in charge



This certificate is consistent with the capabilities that are included in Appendix C of the MRA drawn up by the CIPM. Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement certificates for the quantities, ranges and measurement uncertainties specified in Appendix C (for details see <http://www.bipm.org>).

National Institute of Metrology (Thailand)

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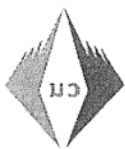
UNCERTAINTY OF MEASUREMENT

The stated uncertainty is the expanded uncertainty obtained by multiplying the standard uncertainty by the coverage factor $k=2$. It has been determined in accordance with EA publication EA-4/02 M:2013 "Evaluation of the Uncertainty of Measurement in Calibration" and JCGM 100:2008 "Evaluation of measurement data --Guide to the Expression of Uncertainty in Measurement (GUM 1995 with minor corrections)". The value of the measured lies within the assigned range of value with a probability of 95 %.

Parameter	Uncertainty at SPL94 dB	Maximum-permitted uncertainty of measurement for a coverage probability of 95%
1.Sound Pressure level	0.08	0.15
2. Frequency	0.1	0.2
3. THD+N	0.2	0.5

TRACEABILITY

This certificate provides traceability of measurement to recognized national standards, and to the realization of the International System of Units (SI).



ENVIRONMENTAL CONDITIONS

Ambient condition in the laboratory are as follows :

Temperature	:	(23.0 ± 1.0)	°C
Pressure	:	(101.325 ± 1.500)	kPa
Relative Humidity	:	(50.0 ± 15.0)	%

Reference Condition : 101.325 kPa , 23.0 °C and 50.0 %RH.

Calibration Condition

Preconditionings : 16 hours at ambient conditions.

Measurement Con : The average values during measurement are
 (100.965 ± 0.013) kPa, (22.3 ± 0.3) °C and (62.2 ± 2.6) %RH

MEASUREMENT METHOD

The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone. The insert voltage technique was employed and the measurement procedure was based on IEC 60942-2017.

Reference Microphone

B&K Type 4180 serial no.1395446

TABULATION OF RESULTS

The following tables give the calibration results and associated measurement uncertainties at 95% of confidence level. The calibration results of sound pressure level which quoted in dB with reference to 20 µPa are corrected to the values under the reference environmental conditions.

The microphone volume corrections and the calibrator pressure corrections are excluded in the calibration results.



MEASUREMENT RESULTS

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value ^[1] (dB)	Acceptance Limit (dB)
Microphone 4180 Serial No.1395446			
94	94.12	0.12	0.25

Note ^[1] : The deviated value is the absolute value of the difference between the measured value and the corresponding specified sound pressure level.

2. Frequency*

Specified Frequency (Hz)	Measured value (Hz)	Deviated value ^[2] (%)	Acceptance Limit (%)
At the sound pressure level of 94 dB			
1000	1000.0	0.0	0.7

Note ^[2] : The deviated value is the absolute value of the difference in percent between the measured value and the corresponding specified frequency.



3. Total distortion + Noise*

Microphone 4180 Serial No.1395446

Measured value ^[3] (%)	Maximum total distortion + Noise (%)
At the sound pressure level of 94 dB	
1.5	2.5

Note ^[3]: The measured value is the total distortion, measured over the frequency range from 20 Hz to 20 kHz. The measured value must not exceed the maximum total distortion + noise appeared in the table.

End of Certificate of Calibration